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Effect of Feeding Frequency and Caloric Intake on Weight Reduction in Obese Females

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EFFECT OF FEEDING FREQUENCY AND CALORIC INTAKE ON WEIGHT REDUCTION IN OBESE FEMALES

by

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Richard Robert Weber

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ABSTRACT

Effect of Feeding Frequency and Caloric Intake

on Weight Reduction in Obese Females

by

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Utah State University, 1976

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Forty-five obese female volunteers were randomly assigned to one of six experimental groups required to consume their daily food intake according to the following feeding frequencies: (a) three isocaloric meals, (b) six isocaloric meals, (c) three isocaloric meals, (d) three meals in the proportion of 1/4:1/4:2/4, (e) six isocaloric meals, and (f) ad libitum (i.e., eight or more isocaloric meals). Members of the first two groups received dietary, nutritional, and exercise management information, while women in the remaining groups received instruction in behavioral control procedures in addition to the aforementioned educative treatment.

Experimental manipulations failed to produce a statistically significant difference in mean weight loss between treatment groups; however, there was a significant negative correlation ($r = -.41$, $p < .01$) between reported mean daily caloric intake and pounds lost at treatment and a significant positive correlation ($r = .38$, $p < .01$) between education in years and pounds lost at treatment. More frequent

feeding and behavioral control instructions were associated with greater mean weight loss at 12-week treatment and 6-month follow-up. Results indicate that for most obese individuals a dietary regimen of five or more minimeals daily may enhance weight reduction and maintenance in treatment programs conducted in the natural environment. Instruction in behavioral control procedures produced substantial intersubject variability in response, yet appeared to facilitate weight loss in most participants. Reduced caloric consumption appeared to be a necessary although not sufficient component of treatment. Methodological considerations and implications for future research were discussed.

(70 pages)

Introduction

Obesity, defined as any body weight in excess of 20% above normal, has been classified as one of the most prevalent health problems in the United States today (U.S. Public Health Service, 1966) and has been estimated to currently affect between 40 and 80 million individuals in the U.S. alone (Stuart & Davis, 1972). Long-term treatment of obesity through a variety of medical and psychotherapeutic interventions has produced only minimal success (Feinstein, 1960; Harris, 1969; Harris & Bruner, 1971; Harris & Hallbauer, 1973; Stunkard & McLaren-Hume, 1959) while behavior modification techniques effect significantly greater weight loss during treatment and superior maintenance of weight loss following treatment (Abrahms & Allen, 1974; Penick, Filion, Fox, & Stunkard, 1971; Wollersheim, 1970) and therefore constitute the most effective reported treatment for obesity (Stunkard, 1972).

The pattern of food ingestion has been shown to markedly alter the metabolism and body composition of various animal species. With identical food intake, reduction in feeding frequency (from ad libitum or unlimited access to spaced meal-eating) in experimental animals is associated with more rapid intestinal absorption of glucose and fat, increased lipogenesis and body fat, elevated serum cholesterol levels, increased glucose synthesis, increased incidence and severity of coronary atherosclerosis, and decreased protein synthesis and water storage (Allee, Romsos, Leveille, & Baker, 1972; Cohn, 1964; Cohn & Joseph, 1960; Cohn, Joseph, Bell, & Oler, 1963; Leveille, 1970; Romsos & Leveille, 1974).

Meal-fed animals apparently become more efficient with regard to energy metabolism and as a consequence are able to gain weight at the same rate as ad libitum eating control animals while ingesting considerably less calories (Allee et al., 1972; Cohn, 1964; Leveille, 1970), or, if forced to consume as much energy as control animals, the meal-fed animal becomes obese (Cohn, 1963).

Homo sapiens appear to react similarly to other species in response to alterations in meal frequency. Serum cholesterol was significantly increased (Cohn, 1964; Fábry & Braun, 1967; Young, Frankel, Scanlan, Simko, & Lutwak, 1971; Young, Hunter, Scanlan, Rand, Lutwak, & Simko, 1972), serum phospholipids and triglycerides were generally increased (Gwinup, Byron, Roush, Kruger, & Hamur, 1963b; Wadhwa, Young, Schmidt, Elson, & Pringle, 1973; Young et al., 1971; Young et al., 1972) while glucose tolerance was significantly reduced (Gwinup, Byron, Roush, Kruger, & Hamur, 1963a; Young et al., 1971; Young et al., 1972) following a decrease in feeding frequency. Epidemiological observations in Czechoslovakia reveal the longitudinal effects of meal frequency under normal living conditions. These studies showed that with fewer meals, there was a marked tendency towards increased body weight, skinfold thickness, and hypercholesterolemia, and decreased glucose tolerance (Fábry, Fodor, Hejl, Braun, & Zvolánková, 1964; Fábry, Hejda, Černý, Ošancová, & Pechar, 1966; Hejda & Fábry, 1964).

Twelve metabolic and clinical experiments examing meal frequency and weight loss have yielded conflicting results. Several investigators (Debry, Rohr, Azouaou, Vassilitch, & Mottaz, 1968; Gordon, Goldberg, & Chosy, 1963; Leveille & Romsos, 1974; Munro, Seaton, & Duncan,

1966; Wadhwa et al., 1973) have concluded that more frequent feedings result in considerably greater weight loss than the traditional pattern of eating three meals a day. Others have found that feeding frequency has no significant effect on weight reduction, skinfold thickness (Bortz, Wroldsen, Issekutz, & Rodahl, 1966; Gordon, 1969; Nunes & Canham, 1963; Swindells, Holmes, & Robinson, 1968; Young, Scanlan, Topping, Simko, & Lutwak, 1971; Young et al., 1972), or body composition (Cohn & Allweiss, 1963).

Thus, there is considerable empirical evidence across species in the animal literature suggesting that meal feeding produces several metabolic alterations that would be contraproductive to effective weight reduction. Research with human volunteers has generally supported these findings; individuals who feed more frequently for extended periods of time lose weight more efficiently. When non-significant results have been obtained, subjects have served as their own controls by participating in the various feeding regimens. Therefore, possible long-term salutary metabolic adaptations due to increased meal frequency would be critically transformed when feeding frequency was reduced. In addition, experimenters strictly controlled food intake (i.e., amount, time, and type of caloric ingestion), regulatory functions normally performed by the dieter in most weight reduction programs in the natural environment.

The relative efficacy of combined behavioral control techniques in the treatment of obesity is well documented (Abramson, 1973; Romanczyk, Tracey, Wilson, & Thorpe, 1973; Stuart, 1971); whereas the relationship between feeding frequency and weight reduction

remains unsettled. The problem is, then, that there has been no reported research on the effectiveness of increased feeding frequency on weight reduction using behavioral techniques in the natural environment.

The purpose of the present study was to investigate the effects of increased meal frequency on weight loss through application of an educative treatment program (i.e., dietary-nutritional and exercise management instruction) alone and in combination with a threefold environmental treatment package (i.e., dietary-nutritional, exercise, and behavioral management instruction). A collateral objective was to examine the relationship between self-reported caloric intake and weight reduction. The hypotheses are:

1. Increased feeding frequency (five or more meals a day) will produce significantly greater mean weight loss in obese individuals as compared to controls eating three meals a day.

2. The environmental treatment program will produce significantly greater mean weight loss in obese individuals than the educative treatment alone.

3. Reported mean daily caloric intake will be significantly greater for obese individuals who lose less than 10 pounds as compared to those who lose 10 or more pounds during treatment.

Review of Literature

This review is limited to an examination of the relative effectiveness of behavioral control procedures in the treatment of overweight individuals and an evaluation of reported research on the effects of feeding frequency on weight reduction in human subjects.

Obesity has many postulated antecedent conditions. Depression, anxiety, power orientation, personality deficiencies, genetic and metabolic factors, insufficient exercise, presence of night-eating syndrome, lack of correlation between reported hunger and gastric motility, obesity of parents, and increased dependence on external stimuli have been suggested as possible causal agents or correlates of obesity (Harris, 1969). Yet, only two common characteristics have been observed in obese individuals: a tendency to overeat and underexercise (U.S. Public Health Service, 1966).

A variety of nonbehavioral treatments have been attempted with dispiriting outcomes; including low-calorie products, exercise salons and reducing clubs, yoga, hypnosis, fasting, dietary instruction, appetite depressants, psychoanalysis and other forms of psychotherapy, group discussion of physical and emotional factors, and general medical advice and supervision (Harris, 1969).

Behavioral Treatment Programs

Successful treatment of obesity must establish and sustain a constant energy deficit by an individual consistently ingesting less and expending more dietary calories than required for body maintenance

(Gordon, 1969; Stuart, 1971; Stuart & Davis, 1972). Behavioral treatment programs have demonstrated repeated success through management of critical aspects of the individual's behavior and environment. Stuart (1967) used a detailed program of self-control or contingency management with eight female subjects designed to increase the frequency of desired overt or covert responses while decreasing the frequency of undesired responses. Over a 12-month treatment period, 80% of the original sample lost more than 20 pounds and 30% lost more than 40 pounds. These results are the best ever reported for outpatient treatment of obesity (Stunkard, 1972) and compare favorably with traditional approaches where only 25% of those who enter treatment lose more than 20 pounds and only 5% lose as much as 40 pounds (Stunkard & McLaren-Hume, 1959).

Wollersheim (1970) compared three group treatments (behavioral self-control, positive expectation-social pressure, and nonspecific therapy) with a no-treatment control in a 12-week treatment program using 79 overweight college females. The behavioral group used food consumption records to provide a functional analysis of their eating behavior, which included the development of stimulus control of eating, self-reinforcement for control of eating, and establishment of alternative responses incompatible with eating. Subjects were also taught deep muscle relaxation to be used when anxiety typically resulted in unwanted eating. The positive expectation-social pressure group was an attempt to duplicate the procedures of weight reduction clubs such as Take Off Pounds Sensibly (TOPS), while the nonspecific therapy group discussed underlying motives and

personality characteristics related to obesity. The behavioral treatment was significantly more effective in promoting weight loss than social presure and nonspecific therapy while these latter treatments were significantly more effective than the no-treatment control. These differences were maintained during the 8-week follow-up.

Penick and his associates (1971) contrasted the effectiveness of group behavioral treatment (using self-control and reinforcement procedures to delay or control the act of eating) with traditional supportive group psychotherapy (including instruction about dieting and nutrition) using 32 obese patients in a 12-week treatment program. Weight losses in the control group after a 3- to 6-month follow-up were comparable to those reported for a variety of treatments in the medical literature; none of the subjects lost 40 pounds and only 24% lost more than 20 pounds. In the behavior modification group, 13% lost more than 40 pounds and 53% lost more than 20 pounds. Because of substantial variability of weight loss within the behavioral group, only losses of over 30 pounds were statistically greater than control group levels.

Stuart (1971) successfully applied a threefold treatment of obesity stressing environmental control of overeating, nutritional planning, and regulated increases in energy expenditure with six overweight women. The 15-week treatment program produced a gradual weight loss of approximately 1 pound per week in the experimental group, while the control group (receiving only dietary planning materials and exercise programs) gained an average of 4 pounds. At the conclusion of this period, the experimental group was asked to continue

the treatment program, while the control group received the same threefold treatment for an additional 15 weeks. A 3-month follow-up showed that subjects in the first group lost an average of 35 pounds while those in the second group lost an average of 21 pounds.

The relative efficacy of financial remuneration, situational eating management, and social pressure procedures were evaluated in an 8-week weight reduction program using 48 overweight women (Abrahms & Allen, 1974). The subjects were randomly assigned from stratified blocks to one of four experimental conditions: no-treatment control, social pressure and reinforcement, behavioral programming with social reinforcement, and behavioral programming with monetary remuneration for weight loss. The subjects in all three treatment groups manifested significantly greater weight losses than controls, with the behavioral programs producing significantly greater weight reduction than social pressure and reinforcement. Weight loss was maintained over a 2-month follow-up period.

Forty case reports and experimental studies of behavioral approaches to weight control were reviewed by Abramson (1973). The treatment programs of aversive conditioning, covert sensitization, coverant conditioning, therapist controlled reinforcement, and self-control of eating were evaluated in terms of their empirical support. The author concluded that self-control procedures appear to be the most promising treatment, particularly when applied in conjunction with therapist controlled reinforcement.

Romanczyk and his associates (1973) examined the major techniques typically applied in behavioral treatment programs for weight reduction

using obese adult volunteers. Their first study compared the effects of no-treatment, self-monitoring of daily weight and caloric intake, symbolic aversion, relaxation training, behavioral management and stimulus control instructions, and contingency contracting using a sequential dismantling strategy (Lang, 1969) in which the techniques of the full therapy package were identified and systematically removed. These treatment procedures resulted in significantly greater weight loss than either the no-treatment control or daily weight recording. Self-monitoring of caloric intake was as effective as the other techniques, either singly or combined, over the 4-week treatment period. Their second study compared the long-term effects of self-monitoring versus the full treatment program used in their first study. The multifaceted behavioral treatment package was significantly more effective than self-monitoring, during both the 4-week treatment period and the 12-week follow-up.

The comparative superiority of the full complement of behavioral techniques in the treatment of obesity has been established. The remaining portion of this review will examine the effects of feeding frequency on weight reduction in human subjects.

Feeding Frequency Research

Cohn and Allweiss (1963) studied six volunteer subjects chosen on the basis of their physical well-being and motivation. They consumed appetizing and nutritious diets in three or six meals daily, with food intake adjusted to individual preferences. Each individual served as his own control. After 6 weeks, no change in body composition could be detected. These results are predictable considering

the extremely short experimental periods and the subjects' consumption of maintenance diets in each of the identified feeding frequencies.

A study of 11 young men fed a measured diet consisting of normal food but containing excess calories was conducted by Nunes and Canham (1963). Subjects were divided into two groups: one group consumed the ration in nine small feedings while the other group ate two small snacks and a large evening meal. After 6 weeks, the groups exchanged dietary patterns. Weight gain occurred in both groups, but the rate of weight gain was not influenced by feeding frequency. These brief experimental periods and interchanging meal schedules mitigate against possible metabolic adaptations that could be attributed to either feeding regimen.

Gordon et al. (1963) used a 1,320 calorie diet high in protein, moderate in fat, and low in carbohydrate and salt in a weight reduction program featuring six approximately equal feedings a day. A 48-hour fast initiated treatment which was designed to break the metabolic pattern of augmented lipogenesis rather than to produce a spectacular loss of weight. Clinical results were particularly encouraging with successful weight loss followed by stepwise increases in food and calorie intake. All patients who evolved through this procedure maintained their weight loss for periods up to 6 months. The results were confounded, in that all subjects received diuretics and most also received triiodothyronine (a most effective compound used to reduce circulating lipid concentrations).

The long-term effects of self-imposed differences in the frequency of meals were examined in 89 healthy men, aged 30 to 50 years,

under their normal living and working conditions as drivers or assistant drivers on long distance trains (Hejda & Fábry, 1964). Consumption was measured for 2 weeks, with three groups identified for comparison: 27 subjects with an average of 3.99 or less meals daily, 46 subjects with an average of 4.0 to 4.99 meals, and 16 subjects with an average of 5.0 or more meals daily. Total daily energy intake was lowest and body weight highest in the first group, while the daily energy intake was highest and body weight lowest in the third group. Skinfold thickness was also inversely related to feeding frequency.

A survey of 379 men aged 60 to 64 years was conducted by Fábry and his colleagues (1964). Subjects were selected at random to represent the male population of that age-group in an urban district of Prague, Czechoslovakia. The number of meals per day was ascertained by interview with a trained dietition, with subjects divided into groups reporting eating: three meals or less per day, three to four meals daily, three to four meals with snacks in between, three to four meals with an additional snack at bedtime, and five meals or more per day. Excessive weight and skinfold thickness were significantly more common among those who took three meals or less daily than among those who took five meals or more daily. Men ingesting three to four meals, with or without additional snacks, showed intermediate values.

Bortz et al. (1966) measured weight loss in six obese females who consumed a liquid-formula diet while confined to a metabolic ward (except for several short-term passes) for a period of approximately 12 weeks. A weight-stabilization period (2,000 to 3,000

calories daily) for each subject preceded the introduction of a hypocaloric diet of 600 calories per day. The initial hypocaloric and stabilization diets were given in three equal feedings, followed by transposing schedules of either one or nine equal meals daily. After rapid initial weight reductions by all subjects, weight losses were linear with time and independent of feeding frequency, suggesting that rate of weight loss was determined by the degree of caloric restriction and not by the pattern of consumption. The type of diet and degree of experimental control over subjects' consumption severely restrict generalization to weight reduction programs conducted in the natural environment. In addition, intrasubject feeding frequency was altered after approximately 3 weeks, an insufficient period of time to permit metabolic adjustments to increased frequency of feeding.

Munro and his associates (1966) required 35 obese female volunteers to consume a 1,000 calorie diet daily in five isocaloric meals. All subjects had participated in a dietetic outpatient program regularly for at least 12 months without success and there was no significant weight loss in the 3 months immediately preceding treatment. Mean weight loss was 9.7 pounds for the 14 subjects who reported strict adherence to the dietary regimen, while mean weight loss was only 2.6 pounds for the 21 subjects who admitted deviation from the prescribed program. This 12-week trial demonstrated that five 200 calorie meals a day were an acceptable form of diet for the majority of subjects and a valuable dietary regimen for those who practice perseverance.

The longitudinal effects of frequent feedings were evaluated in 226 children and adolescents, aged 6 to 16 years, living in one of three boarding schools which served three, five, or seven meals a day (Fábry et al., 1966). Weekly menus were identical in all three schools and no initial significant differences in average daily caloric intake per capita were found. Among older children (boys 11 to 16 years and girls 10 to 16 years) there were significantly greater increases in body weight and skinfold thickness for those who ate three meals a day as compared to those who ate five or seven meals daily. The differences in both parameters were more marked in girls than in boys. There were no significant differences among younger children (boys 6 to 11 years and girls 6 to 10 years) attributable to feeding frequency.

The metabolic responses of six healthy young women who consumed a uniform maintenance diet (meat loaf, ice cream, orange juice, tea, and coffee) for 27 days while confined to a metabolic ward were reported by Swindells et al. (1968). The daily caloric intake of each subject was based on preliminary measurements of their energy expenditure and was consumed in altering feeding frequency regimens of three meals, two meals, three meals, nine meals, and three meals that were each approximately 6 days in length. Body weight of the subjects decreased slightly during most of the treatment periods and there was substantial day-to-day variation in energy expenditure. The investigators suggested that more frequent feeding did not appear to be associated with appreciable weight loss during this short experimental trial and that there might be considerable individual variations in

response to more frequent food intake. These nonsignificant results are predictable considering that subjects consumed maintenance diets during several feeding frequency regimens of excessively brief duration and that the metabolic effects of meal frequency are likely to be modified by total caloric intake, physical activity, and the composition of the diet.

Debry et al. (1968) examined the effects of feeding frequency on weight reduction in 35 obese volunteers during their stay in a convalescent center. Schedules for consumption of the 1,200 to 1,800 calorie diets were irregular: 22 subjects ate three and then six meals a day; 8 subjects ate three meals, seven meals, and then three meals; 3 subjects ate seven meals and then three meals; and 2 subjects ate seven meals, three meals, and then seven meals daily. Mean daily weight loss for all subjects was 78 grams with three meals and 142 grams with seven meals a day. More frequent feeding was clearly more effective in producing weight loss and was recommended for obese subjects refractory to simple dieting.

Several fundamental principles for the treatment of obesity were outlined by Gordon (1969): reduction of caloric intake below metabolic requirements, increased energy output through more physical activity, facilitation of the excretion of water, and assistance in the resolution of serious emotional problems which are often responsible for overeating. The author recommended a diet of six meals a day because it compels the individual to ingest and metabolize protein almost constantly throughout the day while remarkably controlling the sensation of hunger. Despite the excellent practical effectiveness of

this diet, Gordon concluded that actual testing under controlled conditions in his laboratory had failed to show any difference in magnitude or rate of weight loss when compared to identical food intake administered in three meals per day. Regrettably, the author did not present any methodological procedures or empirical evidence supporting his contentions and therefore critical evaluation of his conclusions is not possible.

Young and his colleagues (1971) studied 11 obese young college students who consumed a 1,800 calorie diet daily for a period of approximately 12 weeks. The experiment was divided into three phases: subjects ate three meals per day for 16 days; subjects were randomly divided into groups who ate either one, three, or six meal(s) daily for 35 days; and subjects were randomly redistributed to the various feeding frequencies for the final 35 days. Frequency of feeding had no significant effect on weight loss, although 64% of the subjects lost slightly more weight with more frequent meals. This effect may have been more pronounced had the subjects not served as their own controls, thus preventing any possible longitudinal metabolic adaptations attributable to increased feeding frequency.

Young and his associates (1972) reported the effects of feeding a 2,800 calorie maintenance diet daily to 10 normal college men for a period of 15 weeks. Three equivalent meals per day were consumed by the subjects during the 2 1/2-week baselines which preceded each experimental period. The subjects consumed either one or six meal(s) per day during the first 5-week period and interchanged feeding frequencies in the second period. Body weight was essentially

unchanged and skinfold thickness was not significantly affected by frequency of feeding. Maintenance diets and brief treatment sessions restrict the generalization of these results to weight reduction programs in the natural environment.

The metabolic consequences of feeding frequency were evaluated in 11 normal male college students over a 10-week period by Wadhwa et al. (1973). A maintenance diet (turkey, bread, apples, oranges, raisins, whole milk, and either corn oil or butter oil) was consumed by all subjects in three daily meals in the proportion of 2/8:3/8: 3/8 for the first week. During the first 4-week experimental period, half of the subjects from each group (corn oil or butter oil diets) consumed their daily food ration in 1/8:7/8 portions, the remaining half of the subjects consumed eight isocaloric meals per day. The eating pattern was reversed for all subjects in the final 4-week period. No significant differences in body weight due to feeding frequency were observed in subjects fed the butter oil diet. However, on the corn oil diet, there were differences in body weight of a small magnitude which Wadhwa et al. described as of considerable importance in view of their constancy over the 4-week experimental periods.

In a comprehensive article, Leveille and Romsos (1974) present the metabolic consequences for animals forced to consume their daily food ration in reduced feedings. They found that several anatomical changes occurred: including an increase in the size of the stomach and small intestine (an approximately 40% increase in the rat) with a corresponding increase in the rate of nutrient absorption, and an

increased capacity to store and recall ingested energy. This increased fatty acid synthesis is attained rather quickly in the rat, yet when ad libitum feeding is resumed, the return to normal lipogenic activity requires approximately four times longer. The human animal's metabolic rate is relatively lower and hence adaptation is extremely slow; thus any possible increase in the efficiency of weight reduction for obese individuals due to ad libitum feeding would require a prolonged length of time to appear. The investigators concluded from their experimental evidence that by adhering to meal-times, man has become the architect of his own obesity.

In summary, while there is a considerable body of research on weight reduction, there is an absence of controlled empirical investigations examining the effectiveness of increased feeding frequency on long-term weight loss in obese individuals using a comprehensive behavioral treatment program in the natural environment.

Methods of Procedure

Subjects

The subjects were chosen from among 50 female respondents to a newspaper advertisement (see Appendix A) or public-service radio announcement requesting overweight volunteers for participation in a weight reduction program. Each of these respondents met the following eligibility criteria:

1. Minimum of 18 years of age.
2. Minimum of 15 pounds overweight (according to Metropolitan Life Insurance Company standards, 1959).
3. Expressed desire to lose a minimum of 15 pounds during treatment and to maintain this loss or lose additional weight throughout the 6-month follow-up.
4. Permission from their physician to participate in the combined dietary and exercise management weight reduction program.
5. Not currently receiving treatment or medication for any serious illness.
6. Not currently involved in another weight reduction program or receiving any weight control medication.
7. Not currently pregnant.
8. Submission of a $35.00 refundable deposit.
9. Submission of the signed contingency Contract, Medical Release, and Informed Consent Agreement (see Appendix B).

From this sample of 50 females, 48 subjects were randomly selected and assigned to one of six treatment groups. A total of 45 subjects attended at least 10 of 12 treatment periods and submitted all requisite data. The subjects ranged in age from 18 to 64 years, with an average age of 36.2 years, and were an average of 44.6 pounds overweight. There were 40 married and 5 single women, 21 of whom had some college education. Group means and individual subject's age in years and pounds overweight data are presented in Table 1.

Materials

The subjects received a signed copy of the Contract, Medical Release, and Informed Consent Agreement at the pretreatment weigh-in. Each of the aforementioned experimental criteria were delineated in the contingency Contract which also described the method of deposit repayment. The deposit was refunded periodically at the experimenter's discretion in $5.00 units contingent upon attendance and complete data submission at the weekly treatment meetings. The subjects received $25.00 of their deposit in this manner, with the remaining $10.00 refunded contingent upon submission of body weight data at the 6-month follow-up. Forfeited monies were divided between subjects who fulfilled contractual agreements, while forfeited personal valuables were donated to local nonprofit organizations.

Each subject received a 50-page 3x5 notebook which contained food exchange lists, feeding frequency and caloric intake requirements, and detachable daily caloric record cards. A variety of nutritional and activity handouts (see Appendices C-H) were provided during the first four weeks of treatment. A standard hospital balance scale was used at all weigh-ins.

Table 1

Group Means and Subjects' Age and Pounds Overweight

Groups	Educative Treatment		Environmental Treatment			
	1	2	3	4	5	6
			Age in Years			
Subjects	27	34	24	38	27	38
	21	21	47	20	30	31
	61	52	52	41	20	24
	36	22	29	55	31	18
	25	55	33	45	26	54
	39	45	28	30	44	39
		18	44	38	38	45
		45	64	24	54	
Means	34.8	36.5	40.1	36.4	33.8	35.6
			Pounds Overweight			
Subjects	131	35.5	22	40.5	19	130.5
	16	33.5	132.5	39	58.5	51
	20.5	48	50	113	64	34.5
	37	27	42	17	36	39
	22	20.5	77	44	32.5	30.5
	34	15	44.5	30.5	51	24
		29	46	69	15	31.5
		15	16	61	58.5	
Means	43.4	27.9	53.8	51.8	41.8	48.7

Procedure

Subjects were randomly assigned to one of six experimental groups required to consume their daily food intake according to the following feeding frequencies.

1. Three isocaloric meals.
2. Six isocaloric meals.
3. Three isocaloric meals.
4. Three meals in the proportion of 1/4:1/4:2/4.
5. Six isocaloric meals.
6. Ad libitum (i.e., eight or more isocaloric meals).

Two treatment groups were formed from the above mentioned feeding frequencies: an educative treatment group, comprised of experimental groups one and two, which received dietary-nutritional and exercise management instruction (see Appendices C-G); and an environmental treatment group, comprised of experimental groups three through six, which received instruction in the complete behavioral control package. This threefold treatment program emphasized nutritional and dietary planning, regulated increases in energy expenditure, and elimination or suppression of stimuli and responses associated with problematic eating and strengthening of stimuli and responses associated with adaptive eating patterns (see Appendices C-H). The educative treatment group received instruction in the application of these behavioral control techniques at their concluding treatment session.

The dietary-nutritional management plan for treatment was a food exchange diet that divides the principal food groups (i.e., meat,

cereal, milk, vegetable, and fruit) into lists, each list containing a variety of foods approximately equal in nutritional and caloric value. Dieters were permitted selections within and between food exchange lists, the type and number in accordance with individual caloric limitations and the following minimum daily nutritional requirements:

6 meat exchanges;

3 cereal exchanges;

2 milk exchanges;

2 vegetable exchanges;

2 fruit exchanges.

An individual food plan provided each subject with a recommended daily caloric intake approximately 500 calories below her estimated weight maintenance level and sought to produce a weekly weight loss of 1 pound (3,500 calories = 1 pound of body fat). Additional weekly weight loss or compensation for dietary deviations was sought through recommended increases in daily energy expenditures. Subjects were encouraged to gradually initiate and increase present daily activity levels by 250 calories to promote an additional weekly weight loss of 1/2 pound.

The two treatment groups met separately for 1 hour each week for 12 treatment sessions. Subjects were weighed privately in lightweight clothing without shoes prior to each treatment meeting, at pre- and posttreatment, and at the 6-month follow-up. The experimenter announced weekly weight variations (i.e., net gain or loss) after each weighing and adjusted recommended individual caloric intake

when necessary to facilitate an optimum weekly weight loss of 1 to 2 pounds. Subjects with a daily caloric intake below the aforementioned minimum nutritional standards were advised to consult their physician concerning vitamin and mineral supplements. A comprehensive description of this threefold treatment program was presented by Stuart and Davis (1972).

Results

The reliability of self-reported feeding frequency and caloric intake was evaluated through observations made by significant other persons. Subjects were required to recruit an observer who agreed to periodically examine and validate by signature recorded food data. There were a total of 417 observations throughout the treatment period, with a mean of 9.3 and a range of 0 to 20 verifications per subject. Interobserver reliability was 100%; i.e., there were no reported discrepancies between self-reported and observed feeding frequency and caloric consumption. The reliability of self-reported caloric expenditure was not ascertained; therefore, these data may only be considered an estimate of actual mean daily energy expenditure through exercise.

Individual and group mean daily feeding frequency, caloric intake, and energy expenditure for treatment, and weight change for treatment and follow-up are presented in Table 2. These data served as the basis for statistical analysis through computation of a one-way analysis of variance for unequal numbers of subjects. Comparison of the efficacy of feeding frequency, educative, and environmental treatment showed no statistically significant differences in mean group weight loss following treatment or 6-month follow-up (see Table 3). Thus, the manipulation of meal frequency and treatment procedure did not significantly alter individual body weight. The mean cumulative weekly weight loss for each experimental group throughout treatment and at 6-month follow-up is presented in Figure 1.

Table 2

Individual and Group Feeding Frequency, Caloric Intake and Expenditure, and Weight Change in Pounds at Treatment and Follow-Up

	Mean Feeding Frequency	Mean Daily Calories		Weight Change in Pounds	
		Intake	Expenditure	Treatment	Follow-Up
	Group 1: Educative Treatment, Three Isocaloric Meals Daily				
Subjects	3	1461	29	-15	-10 *
	4.2	997	126	-13.5	-10.5
	2.5	836	32	-10.5	-12.5
	3	1081	89	-7	0
	3	952	42	-4	-1.5
	3	1243	34	-16.5	-11
Means	3.1	1095	59	-11.1	-7.6
	Group 2: Educative Treatment, Six Isocaloric Meals Daily				
Subjects	3.4	1090	172	-17.5	-11.5
	4	1227	120	-13	-13.5
	4.5	1242	42	-11	-7
	4.6	1020	82	-11	-1
	5.2	1117	4	-4.5	+ .5
	4.4	1143	38	-16.5	-15
	5.9	1265	273	-4	-16.5
	5	1505	47	-8	-11.5
Means	4.6	1201	97	-10.7	-9.4

Table 2

Continued

	Mean Feeding Frequency	Mean Daily Calories		Weight Change in Pounds	
		Intake	Expenditure	Treatment	Follow-Up
Group 3: Environmental Treatment, Three Isocaloric Meals Daily					
Subjects	3	1112	196	-8.5	+1 *
	3	950	443	-10	-10.5
	3	833	304	-16.5	-11
	3	695	223	-10.5	-14
	3	782	265	-21	-20
	2.9	1210	195	-20.5	-26
	3	1033	217	-9	-6
	3	1114	152	-12.5	-8.5
Means	3	966	249	-13.6	-11.9
Group 4: Environmental Treatment, Three Meals Daily, Proportion 1/4:1/4:2/4					
Subjects	3	990	147	-7.5	-3
	3.1	1064	225	-6.5	-2 *
	2.9	758	1069	-33	-20
	3	949	144	-8.5	-4.5
	3	785	158	-5	+5.5
	2.9	429	250	-9	-8
	3	1176	105	-8	-3.5
	3	1033	133	-12.5	-1.5*
Means	3	898	279	-11.3	-4.6

Table 2

Continued

	Mean Feeding Frequency	Mean Daily Calories		Weight Change in Pounds	
		Intake	Expenditure	Treatment	Follow-Up
Group 5: Environmental Treatment, Six Isocaloric Meals Daily					
Subjects	3.8	969	367	-18.5	-13
	4.6	693	153	-19.5	-25.5
	4.6	1011	430	-6	-14
	4.5	999	131	-7.5	-19
	4.2	1685	1286	-4	-6
	4.2	682	225	-40	-46.5
	5	1017	107	-14	-13
	5.4	871	184	-17.5	-17.5
Means	4.5	991	360	-15.9	-19.3
Group 6: Environmental Treatment, Ad Libitum (8 or More Isocaloric Meals Daily)					
Subjects	5.9	1456	112	+4.5	+19.5
	7	853	194	-34	-46.5
	7.3	1196	361	-17	-15
	5.7	1123	292	-3	+1.5
	6.8	1159	173	-11.5	-1
	6.3	966	517	-11.5	-6
	5.9	927	315	-16.5	-3.5
Means	6.4	1097	281	-12.7	-7.3

*Pregnant

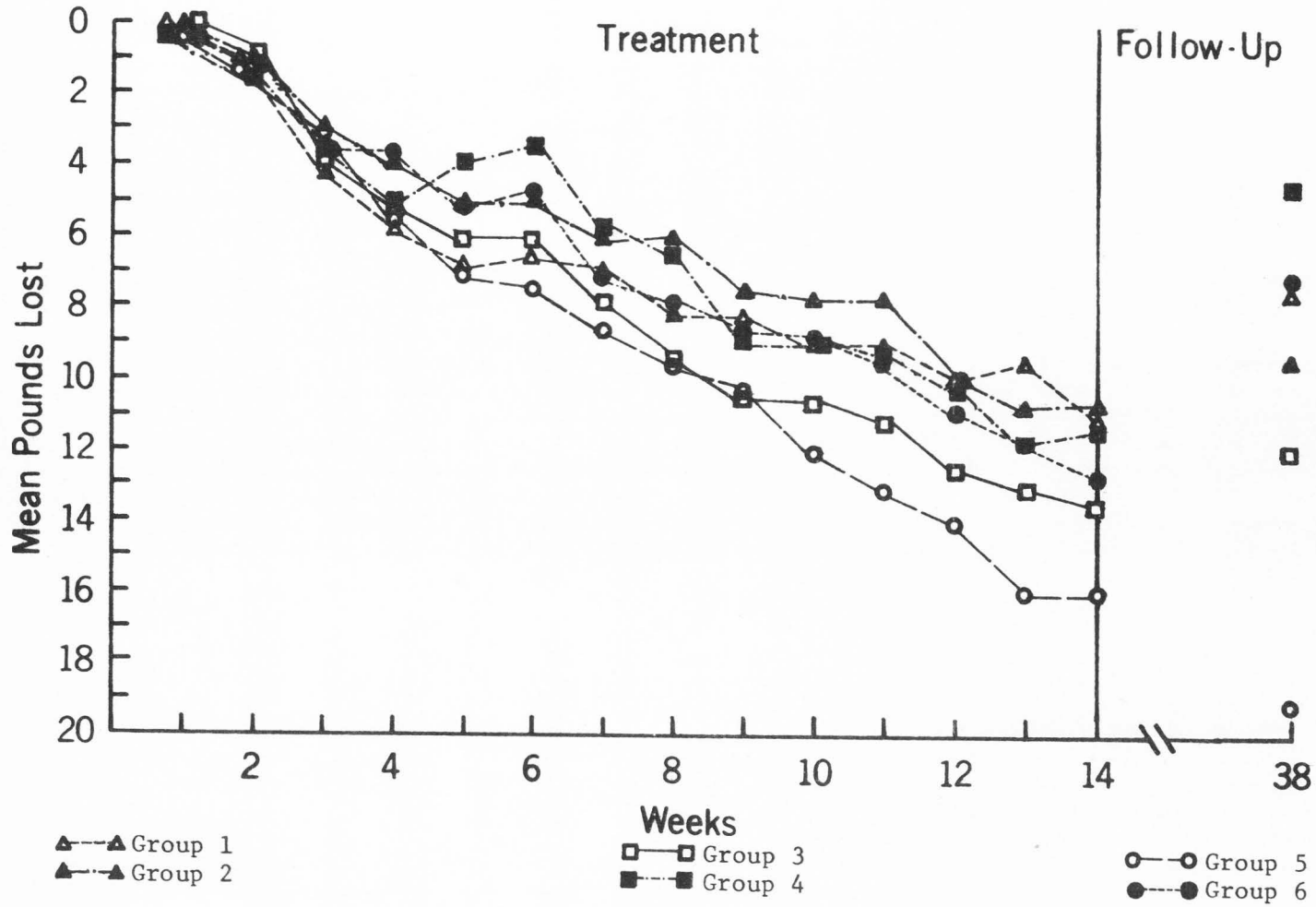

Figure 1. Mean cumulative weekly weight loss in pounds for each experimental group for treatment and 6-month follow-up.

Table 3

Analysis of Variance for Pounds Lost
at Treatment and Follow-Up

Source	df	MS	F
	Treatment		
Between Group	5	30.18	.41
Within Group	39	72.95	
	Follow-Up		
Between Group	5	208.11	1.69
Within Group	39	122.95	

The mean weight loss at treatment and follow-up for women reporting consumption of an average of three meals or less daily and for those reporting consumption of an average of more than three meals daily is presented in Table 4. Individuals who ingested meals more frequently evidenced greater, although nonsignificant, mean weight loss at treatment and follow-up than those who ate less frequently.

The mean weight loss for the educative and environmental treatment groups at treatment and follow-up is presented in Table 5. Members of the environmental treatment group showed greater, although nonsignificant, mean weight loss at treatment and follow-up than the educative treatment group members. Environmental treatment produced substantial intersubject variability in response, with the largest weight gains and losses occurring in this group.

There were 27 subjects who lost 10 or more pounds during treatment, or 60% of the final sample. This weight loss was attained by 52% of the women who ate three meals or less daily and 67% of the women who ate more than three meals daily. The mean feeding frequency for the latter group was 5.1, with a range of 3.4 to 7.3 meals a day. This weight loss was maintained at the 6-month follow-up by 43% of the three meals or less group and 63% of the more than three meals daily group.

Mean daily caloric intake during treatment was 999 calories for subjects who lost 10 or more pounds and 1096 calories for subjects who lost less than 10 pounds. Analysis of these data through use of a *t*-test for uncorrelated means showed no statistically significant

Table 4

Reported Daily Feeding Frequency and Mean Weight Loss in Pounds at Treatment and Follow-Up

Daily Feeding Frequency	Mean Weight Loss in Pounds	
	Treatment	Follow-Up
Three meals or less	12.0	8.0
More than three meals	13.1	12.2

Table 5

Educative and Environmental Treatment Group Mean Weight Loss in Pounds at Treatment and Follow-Up

Groups	Mean Weight Loss in Pounds	
	Treatment	Follow-Up
Educative treatment	10.9	8.6
Environmental treatment	13.4	10.9

difference ($t(43) = 1.38$, $p<.10$) in reported mean daily caloric intake between groups; thus, individual weight loss was not significantly affected by caloric intake.

The Pearson product-moment correlation coefficient was used to examine the relationship between the following variables: (a) mean daily caloric intake and feeding frequency, (b) mean daily caloric intake and pounds lost, (c) age in years and pounds lost, (d) caloric expenditure and pounds lost, (e) education in years and pounds lost, (f) feeding frequency and pounds lost, and (g) pounds overweight

and pounds lost (see Table 6). A significant negative correlation (r = -.41, p<.01) was found between reported mean daily caloric intake and pounds lost at treatment. There was also a significant positive correlation (r = .38, p<.01) between education in years and pounds lost at treatment. All other correlation coefficients were nonsignificant, indicating only a very slight relationship exists between these investigated variables.

Subjects evaluated the effective components of their weight reduction program in a Questionnaire (see Appendix I) completed at the conclusion of treatment. Individual open-response ratings were scored as follows: 1 = 3 points, 2 = 2 points, and 3 = 1 point. The educative and environmental treatment groups ratings of the effective components of treatment for totals of 5 points or more is presented in Table 7. Both treatment groups rated the food exchange diet-daily caloric record and the weekly weigh-in as the most beneficial components of treatment. While only two women indicated any dissatisfaction with their prescribed feeding frequency, both were members of the ad libitum group required to eat eight or more isocaloric meals daily.

Three subjects terminated treatment prematurely and forfeited their deposit. The two women who surrendered a personal valuable (i.e., movie projector and wristwatch) in lieu of the monetary deposit were among those who terminated prior to completion of treatment.

Table 6

Summary of Pearson Product-Moment Correlation Coefficients

Variables	Correlation Coefficients
Mean Daily Caloric Intake and Feeding Frequency	.22
Mean Daily Caloric Intake and Pounds Lost	-.41*
Age in Years and Pounds Lost	.10
Caloric Expenditure and Pounds Lost	.15
Education in Years and Pounds Lost	.38*
Feeding Frequency and Pounds Lost	.04
Pounds Overweight and Pounds Lost	.09

*$p < .01$ for one-tailed test.

Table 7

Educative and Environmental Treatment Group Point Ratings of Effective Components of Treatment

	Effective Components				
Groups	Food Exchange Diet	Daily Caloric Record	Weekly Weigh-in	Behavioral Procedures	Exercise
Educative Treatment	11	16	32		
Environmental Treatment	30	25	39	23	17

Discussion and Conclusions

Statistical analysis of the data failed to provide sufficient evidence to support the hypotheses:

1. Increased feeding frequency (five or more meals a day) will produce significantly greater mean weight loss in obese individuals as compared to controls eating three meals a day.

2. The environmental treatment program will produce significantly greater mean weight loss in obese individuals than the educative treatment alone.

3. Reported mean daily caloric intake will be significantly greater for obese individuals who lose less than 10 pounds as compared to those who lose 10 or more pounds during treatment.

However, examination of the data does provide information relevant to the clinical treatment of overweight individuals in the natural enivronment.

While increased feeding frequency (four to seven minimeals daily) did not produce a significantly different weight change at treatment or follow-up, individuals who consumed more frequent meals were more successful in weight reduction and maintenance. The relative superiority of more frequent feeding was most evident at follow-up, possibly due to physiological and enzymatic adaptations which enhanced weight loss over time.

Schachter (1971) postulated that obese individuals were stimulus-bound and regulated their food consumption on the basis of external

food-relevant cues rather than proprioceptive cues that determine the eating behavior of normals. He observed that high stimulus prominence was associated with greater food consumption for obese subjects as compared to normals. The present study found that feeding frequency was not correlated with caloric intake, indicating that more frequent exposure to food (i.e., high stimulus prominence) at prescribed meal times did not result in a concomitant increase in calories consumed. Increased feeding frequency apparently served as an effective practical dietary regimen that enabled most individuals to control the sensations of hunger without overeating. Thus, it may be concluded that the direction of the results support the findings of other investigators (Debry et al., 1968; Gordon et al., 1963; Gordon, 1969; Leveille & Romsos, 1974; Munro et al., 1966; Norton, 1966) who suggest that more frequent feeding facilitates weight loss, and extend the generalization of the data to weight reduction programs conducted in the natural environment.

Participants in the threefold environmental treatment program evidenced greater mean weight loss at treatment and follow-up than members of the educative treatment group. Instruction in behavioral control procedures produced substantial intersubject variability in weight loss yet did not affect significant differential weight loss between treatment groups. These data fail to replicate the findings of previous experimenters (Penick et al., 1971; Stuart, 1971) who observed marked differences in weight loss in behavior modification groups as compared to educative treatment groups. Stuart's (1971) pilot investigation used individual treatment in three-subject groups

which he described as too small to permit generalization without extensive replication using experimental control procedures applied to a more diverse population. Penick and his associates (1971) attempted replication with 32 obese individuals and found statistically significant differences between behavior modification and control groups for weight losses over 30 pounds at treatment, but not for weight losses of over 20 and 40 pounds. They observed far greater variability of results in the behavior modification group which mitigated against statistical significance at treatment and follow-up.

The absence of significance in the present investigation may possibly be attributed to an apparent artifact of group behavioral treatment, i.e., behavior modification may be remarkably effective for certain overweight individuals and quite ineffective for others (Penick et al., 1971). The significant positive correlation ($r = .38$, $p<.01$) between education in years and pounds lost at treatment explains some of the variability of response, yet, these data are insufficient to differentiate responders to behavior modification from nonresponders. Thus, the development of predictors of response to behavioral control procedures, and if possible, remedial measures for nonresponders, could mean a significant advance in the treatment of obesity.

Reported mean daily caloric intake was not significantly greater for women who lost less than 10 pounds as compared to those who lost more than 10 pounds during treatment; however, there was a significant negative correlation ($r = -.41$, $p<.01$) between reported mean daily caloric intake and pounds lost at treatment. The correlation coefficient accounts for only 17% of the common variance in the identified

variables, which suggests the influence of other factors in the weight reduction formula. Although the present study found no significant relationship between reported mean daily caloric expenditure and pounds lost, several investigators (Lamb, 1974; Mahoney & Mahoney, 1976; Morehouse & Gross, 1975; Stuart & Davis, 1972) have emphasized the importance of regulated energy expenditure in a weight reduction regimen to enhance the loss of body fat and inhibit the loss of muscle mass. No other examined variables had any apparent relationship to weight loss.

Examination of the effectiveness of the present weight reduction program indicates mean individual weight loss (12.5 pounds) approximated 1 pound per week during treatment; results comparable to the best reported in the literature for group behavioral treatment of obesity in the natural environment (Hall & Hall, 1974). Regrettably, mean individual weight loss at follow-up (10.2 pounds) was not increased or maintained; results consistent with those generally found to occur in controlled weight reduction studies with follow-up periods of 6 months or more (Hall, 1973; Hall & Hall, 1974). Individual ratings of beneficial treatment components and unsolicited anecdotal reports at follow-up suggest that required periodic weigh-ins may enhance or maintain weight loss following termination of treatment. Subjects requesting assistance in achieving or maintaining ideal weight loss after treatment could be permitted to extend contractual commitment (Tighe & Elliott, 1968), with a portion of surrendered monies returned contingent upon attendance at biweekly weighings and submission of daily caloric intake and expenditure records when indicated. An additional portion

of the deposit could be refunded contingent upon attainment or maintenance of a mutually acceptable goal weight. Clinical examination of the effect of contracted weigh-ins and caloric records on post-treatment weight loss will be undertaken in a subsequent experiment.

Evaluation of the present contingency Contract suggests it contributed substantially in reducing subject attrition. The low premature termination rate (6%) compares favorably with values reported in the medical (20-80%) and behavioral (0-83%) literature (Hall & Hall, 1974; Stunkard, 1972). The type of deposit apparently affected the attrition rate, with 100% of the women who submitted a personal valuable, and only 2% of those who submitted monies failing to complete treatment. Careful selection of a number of valuable personal items appears necessary to increase the probability of obese individuals attending prescribed treatment sessions (Mann, 1972). The 100% attendance at the 6-month follow-up may be attributed to the interaction of geographical proximity, contractual commitment, and experimenter perseverance.

In conclusion, although no significant results were obtained, it appears that for most obese individuals, a dietary regimen of five or more minimeals daily may facilitate weight reduction and maintenance in treatment programs conducted in the natural environment. Instruction in behavioral control procedures also appears to be an important adjunct to the dietary-nutritional and exercise management package for most participants in treatment. Finally, reduced caloric consumption seems to be a necessary although not sufficient component in effective weight reduction programs.

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Appendices

Appendix A

Newspaper Advertisement

Wanted - Overweight volunteers to participate in university approved scientific weight reduction program. Must be 18 years or older, not currently in another weight program, and want to lose at least 15 pounds. Call Richard Weber at 752-4816 for details.

Appendix B

Contract, Medical Release, and

Informed Consent Agreement

I _____ _____ have consulted and received permission from my physician to participate in the combined dietary and exercise management weight reduction program. I am not currently receiving treatment or medication for any serious illness and I therefore absolve the program administrator from any future legal actions that might result from my participation in this program.

I agree to submit a $35.00 deposit (or its equivalent in personal goods) which will be refunded periodically at the administrators discretion in $5.00 units contingent upon perfect attendance and complete data submission at all weekly treatment periods preceeding each declaration of repayment. I understand I must attend at least 10 of the 12 treatment periods, and must notify the administrator of any necessary absence prior to meeting time. If I fail to attend or submit weight reduction data at any treatment period prior to a declaration of repayment, or fail to contact the administrator prior to an absence I forfeit the opportunity to receive the declared $5.00 repayment. I understand that all forfeited monies will be divided equally between individuals who have qualified for repayment in that payment period. I agree that $25.00 of my deposit be refunded in this manner, with the remaining $10.00 to be refunded contingent upon my submission of verified weight reduction data to the administrator 6 months following termination of treatment.

I am not currently involved in any other weight reduction program nor am I presently using any weight control medications. I have an expressed desire to lose at least 15 pounds during treatment and wish to maintain this loss or lose additional weight throughout the 6-month follow-up period. I agree to contact a significant other person who will be permitted to periodically varify my personal weight control data through inspection of my daily caloric intake record. I understand that I may withdraw from this program at any time.

_____ _____

My Age Today Participant's Signature

_____ _____

Today's Date Administrator's Signature

Appendix C

Baseline Eating Monitoring Form*

FOOD EATEN Quantity	FOOD EATEN Type of food	TIME Circle time if food was part of meal	SOCIAL Alone?	SOCIAL With whom?	WHERE EATEN Home Work Restaurant Recreation	MOOD WHEN EATEN A-Anxious B-Bored C-Tired D-Depressed E-Angry

*From Stuart, R. B., & Davis, B. Slim chance in a fat world--behavioral control of obesity. Champaign, Ill.: Research Press, 1972.

Appendix D

Food Exchange Lists and Exercise Plan in 3x5 Notebook*

FOOD EXCHANGE LISTS

CALORIE-FREE FOODS
(Negligible calories)

Bouillon, broth
Coffee, tea
Cranberries, rhubarb
Herbs, spices
Gelatin, rennet tablets
Lemon, lime juice
Pickles (unsweetened)
Mustard, soy sauce, vinegar
Saccharin
Raw vegetables

MEAT EXCHANGE LIST
(75 calories per exchange)

Low fat content		Higher fat content	
Chicken, veal, organ meats, game meats, fish	1 oz	Beef, duck, goose, ham, lamb, pork	1 oz.
Crab, lobster, salmon, tuna	1/4 cup	Eggs	1
Clams, oysters, scallops shrimp	3–5 medium	Cheese	1 slice or 1 oz.
Cottage cheese	1/3 cup	Peanut butter	1 tablespoon
		Cold cuts, frankfurters, sausage	1 small or 1 slice

CEREAL EXCHANGE LIST
(170 calories per exchange)

Bread	1 slice	Noodles	1/2 cup
Bagel, bun, English muffin	1/2	Corn, dried peas and beans, parsnips, potatoes	1/2 cup
Biscuit, roll, muffin	1		
Pancake, waffle	1 4" diam	Tomato sauce, catsup	1/4 cup
Crackers, saltine or round	5	Soup, meat or vegetable	1 serving (3 per can)
Crackers, rye	2 double	Soup, cream, pea, or bean	1/2 serving (3 per can)
Cereal, cooked	1/2 cup		
Cereal, ready-to-eat	3/4 cup		

MILK EXCHANGE LIST
(85 calories per exchange)

Milk, buttermilk, plain yogurt (skimmed)	1 cup
Milk, yogurt (partially skimmed)	3/4 cup
Cottage cheese (creamed), ice milk	1/3 cup

VEGETABLE EXCHANGE LIST
(3 exchanges, 50 calories)

List 1. (1/2 to 1 cup)

Asparagus	Cucumber	Lettuce
Bamboo shoots	Eggplant	Mushrooms
Broccoli	Endive	Okra
Brussels sprouts	Green beans, young	Peppers
Cabbage	Green onions	Radishes
Cauliflower	Greens	Sauerkraut
Celery	Kohlrabi	Summer squash
		Watercress

List 2. (1/2 cup)

Artichokes	Pea pods
Beets	Pumpkin
Carrots	Rutabagas
Onions	Turnips
Peas	Winter squash

FRUIT EXCHANGE LIST
(40 calories per exchange)

Apple, guava, orange, peach, pear, tomato	1	Apricots, figs, plums	2
		Blackberries, blueberries, raspberries, strawberries, watermelon	1 cup
Juice: apple, grapefruit, orange, pineapple	1/2 cup		
Tomato juice	1 cup	Applesauce, pineapple	1/2 cup
Banana, grapefruit, mango, papaya	1/2	Cherries, grapes	12
		Cantaloupe	1/4

MISCELLANEOUS FOODS EXCHANGE LIST
(40 calories per exchange)

List 1. (Fats)

Avocado	1/8 4-in. diam.		
Bacon, crisp	1 slice	Cream, heavy or sour, cream cheese, French dressing	1 tablespoon
Butter, margarine, mayonnaise, oil	1 teaspoon		
Cream, light	2 tablespoons	Nuts	6 small
		Olives	5 small

List 2. (Sweets)

Hard candy (small) or caramel	1
Sugar, syrup, honey, jam, jelly, cocoa	1 level tablespoon or 1 heaping teaspoon

List 3. (Desserts and beverages) These foods, in the amounts specified, supply approximately 80 calories and must be counted as 2 miscellaneous food exchanges.

Cake: sponge, angelfood	1 small piece	Beer, carbonated beverages	6 ounces
Jello	1 serving (5 per package)	Gin, rum, whiskey, liqueur	1 ounce
Sherbet	1/3 cup	Wine (red, sweet)	2 ounces
		Wine (light, dry)	3 ounces

EXERCISE PLAN*

LIGHT EXERCISE	Each box = 5 min. = 20 calories	x20 =
MODERATE EXERCISE	Each box = 5 min. = 35 calories	x35 =
HEAVY EXERCISE	Each box = 5 min. = 50 calories	x50 =
	DAILY TOTAL	

*Caloric values are for gross energy expenditure.

*From Stuart, R. B., & Davis, B. Slim chance in a fat world--behavioral control of obesity. Champaign, Ill.: Research Press, 1972.

Appendix E

Food Exchange Lists*

All foods within each exchange list, in the amounts specified, are approximately equal in caloric content. It is essential that foods be weighed or measured until portions can be estimated accurately.

CALORIE-FREE FOODS

The following foods, seasonings, and beverages either have negligible calories or no calories at all. They may be used freely in reasonable amounts and do not have to be recorded on the daily food plan.

All raw vegetables from the vegetable exchange list

Bouillon
Broths, clear (no fat)
Coffee
Cranberries (unsweetened)
Garlic
Gelatin (unflavored)
Herbs
Horseradish
Lemon juice
Lime juice
Mustard
Onion flakes
Pickles (dill, unsweetened)
Pickles (sour)
Rennet tablets
Rhubarb (unsweetened)
Saccharin
Soy sauce
Spices
Tea
Vinegar

MEAT EXCHANGE LIST

Each meat exchange supplies approximately 75 calories of energy. The lean meats will average somewhat less than this amount and the fat meats somewhat more. An average serving portion of cooked meat weighs approximately 3 ounces, which would be 3 meat exchanges. At least 2 serving portions of meat or meat products (6 exchanges) should be eaten daily.

List 1. The following are lean meats and low-fat cheeses, and increased use of these is encouraged:

Exchange	Amount to Use for 1 Exchange
Meat and poultry	
Chicken, game meats, liver and other organ meats, pheasant, rabbit, turkey, veal	1 ounce

*From Stuart, R. B., & Davis, B. Slim chance in a fat world--behavioral control of obesity. Champaign, Ill.: Research Press, 1972.

Fish	
Bass, cod, flounder, haddock, halibut, lobster, salmon, trout, etc.	1 ounce
Crab, lobster, salmon, tuna	1/4 cup (loosely packed)
Clams, oysters, scallops, shrimp	3-5 medium
Cheese	
Cottage cheese	1/3 cup
Skimmed or partially skimmed milk	1 1-inch cube or 1 ounce

List 2. The following meat exchanges contain more fat; these should be used more sparingly.

Meat and poultry	
Beef, duck, goose, ham, lamb pork	1 ounce
Eggs	1 egg
Cheese	
American (processed), cheddar, Edam, Swiss, etc.	1 slice (4x4x1/8 inches) or 1 1-inch cube or 1 ounce
Peanut Butter	1 tablespoon
Cold cuts: bologna, salami, etc.	1 slice (4 1/2 x 4 1/2 x 1/8 inches)
Frankfurters (8-9 per lb.)	1 small
Sausage	1 small link

CEREAL EXCHANGE LIST

Each cereal exchange supplies approximately 70 calories of energy. Soups and high-carbohydrate vegetables have been included on the cereal exchange list. At least three servings of whole grain or enriched breads or cereals should be eaten daily.

Exchange	Amount to Use for 1 Exchange
Breads and rolls	
Bagel	1/2
Bread dressing or stuffing	2 tablespoons
Hamburger, hot dog bun (large)	1/2 bun
Matzos	1 6-inch diameter
White, whole wheat, rye	1 slice
Quick breads	
Biscuit, roll, muffin	1 2-inch diameter
Corn bread	1 piece 1 1/2-inch cube
Doughnut, plain	1 small
English muffin	1/2
Pancake	1 4-inch diameter cake
Waffle	1 4-inch diameter waffle

Crackers	
Graham	2 crackers, 2 1/2-inches square
Oyster	1/2 cup
Round	5 crackers, 2-inches diameter
Rye	2 double crackers
Saltines	5 crackers, 2-inches square
Soda	3 crackers, 2 1/2-inches square
Cereals	
Cooked: grits, oats, rice, wheat	1/2 cup
Ready-to-eat: flake and puff types	3/4 cup
Pastas (cooked, noodles only)	
Egg noodles, macaroni, spaghetti	1/2 cup
Flour	2 1/2 tablespoons
Vegetables and soups	
Baked beans in sauce (no pork)	1/4 cup
Corn	1 small ear or 1/2 cup kernels
Dried beans, lentils, peas (cooked)	1/2 cup
Parsnips	1/2 cup
Popcorn (no butter)	1 cup
Potatoes	1 small or 1/2 cup mashed
Potatoes, sweet or yams	1/4 cup
Tomato sauce or catsup	1/4 cup
Soup, meat or vegetable	1 serving (3 per can)
Soup, cream, pea, or bean	1/2 serving (3 per can)

MILK EXCHANGE LIST

Each milk exchange supplies approximately 85 calories of energy. Skimmed or partially skimmed milk should be used. Two cups of milk or its equivalent should be drunk daily.

Exchange	Amount to Use for 1 Exchange
Buttermilk (skimmed)	1 cup (8 ounces)
Cottage cheese (creamed)	1/3 cup
Cottage cheese (plain)	1/2 cup
Evaporated milk	1/4 cup
Evaporated milk (skimmed)	1/2 cup
Ice milk	1/3 cup
Nonfat dried milk powder	1/4 cup
Partially skimmed milk	3/4 cup
Skimmed milk	1 cup
Yogurt, plain (made from partially skimmed milk)	3/4 cup
Yogurt, plain (made from skimmed milk)	1 cup
Yogurt, fruit and flavored	1/2 cup

VEGETABLE EXCHANGE LIST

Three vegetable exchanges (two from the first list and one from the second) supply approximately 50 calories. The vegetables in upper-case type are especially rich sources of vitamins. At least two servings of vegetables should be eaten daily, including one vitamin-rich vegetable.

List 1. The following vegetables provide negligible calories. In raw form they may be eaten as desired in reasonable amounts and do not need to be recorded on the daily food plan. When cooked, limit serving portions to 1/2 to 1 cup and record as one vegetable exchange.

ASPARAGUS
Bamboo shoots
Broccoli
BRUSSELS SPROUTS
CABBAGE
Cauliflower
Celery
Cucumber
Eggplant
Endive
Green beans, young
Green onions
GREENS
  BEET GREENS
  CHARD
COLLARDS
DANDELION GREENS
KALE
MUSTARD GREENS
SPINACH
TURNIP GREENS
Kohlrabi
Lettuce
Mushrooms
Okra
PEPPERS
Radishes
Sauerkraut
Summer squash
WATERCRESS

List 2. The following vegetables contain more carbohydrates and therefore provide more calories. When cooked, average one serving of these vegetables daily, but limit serving portions to 1/2 cup and count as one vegetable exchange. When used in the raw form, it is not necessary to record these as a vegetable exchange on the daily food plan, but use these raw vegetables less frequently than those from List 1.

Artichokes
Beets
CARROTS
Onions
Peas
Pea pods
PUMPKIN
Rutabagas
Turnips
WINTER SQUASH

FRUIT EXCHANGE LIST

Each fruit exchange provides approximately 40 calories of energy. Fruits may be fresh, dried, cooked, canned, or frozen as long as no sugar is added. Those in upper-case type are especially rich in vitamin C. Two exchanges of fruit should be eaten daily, with a least one being a vitamin C-rich fruit.

Exchange	Amount to Use for 1 Exchange
Apple	1 small or 1/2 medium
Apple juice	1/2 cup
Applesauce	1/2 cup
Apricots	2
Apricots, dried	4 halves
Banana	1/2 small
Blackberries	1 cup
Blueberries	1 cup
CANTALOUPE	1/4 small
Cherries	12
Figs, fresh	2
Grapes	12
Grape juice	1/4 cup
GRAPEFRUIT	1/2 small
GRAPEFRUIT JUICE	1/2 cup
Guava	1
Honeydew melon	1/8
Mango	1/2 small
ORANGE	1 small
ORANGE JUICE	1/2 cup
Papaya	1/2 small
Peach	1
Pear	1 small
Pineapple	1/2 cup
Pineapple juice	1/2 cup
Plums	2
Raisins	2 tablespoons
Raspberries	1 cup
STRAWBERRIES	1 cup
TOMATO	1 large
TOMATO JUICE	1 cup
Watermelon	1 cup

MISCELLANEOUS FOODS EXCHANGE LIST

These foods and beverages provide concentrated sources of calories. Those in upper-case type supply only calories and are called "empty calorie foods." They should be used sparingly.

List 1. (Fats). Each of these provides approximately 40 calories per exchange. Those underscored are good sources of polyunsaturated fatty acids.

Exchange	Amount to Use for 1 Exchange
Avocado	1/8 4-inch diameter
Bacon, crisp	1 slice
Butter or margarine	1 teaspoon
Cream, light	2 tablespoons
Cream, heavy or sour	1 tablespoon

Cream cheese	1 tablespoon
French dressing	1 tablespoon
Mayonnaise	1 teaspoon
Nuts	6 small
Oil or cooking fat	1 teaspoon
Olives	5 small

List 2 (Sweets). The following sweets provide approximately 40 calories per exchange.

Exchange	Amount to Use for 1 Exchange
Cocoa (sweetened)	1 level tablespoon or 1 heaping teaspoon
HARD CANDY (SMALL) OR CARAMEL	1
SUGAR, SYRUP, HONEY, JAM, JELLY	1 level tablespoon or 1 heaping teaspoon

List 3 (Desserts and beverages). These foods, in the amounts specified, supply approximately 80 calories and must be counted as 2 miscellaneous food exchanges.

Exchange	Amount to Use for 2 Exchanges
Desserts	
Cake: sponge, angel food, made with enriched flour	1 piece, 2x2x1 inches
Jello	1 serving (5 per package)
SHERBET	1/3 cup
Any dessert, if 1 serving portion is no more than 80 calories	1 serving
Beverages	
Beer	6 ounces
CARBONATED BEVERAGES	6 ounces
GIN, RUM, WHISKEY*	1 ounce
LIQUEUR (creme de menthe, etc.)	1 ounce
WINE (red, sweet)	2 ounces
WINE (light, dry)	3 ounces

*One jigger is 1 1/2 ounces and would be counted as 3 miscellaneous food exchanges.

Appendix F

Food Selection and Preparation Suggestions*

MEAT EXCHANGES

1. Increase the use of the leaner meats, seafoods, cottage cheese, and skim milk cheeses.

2. Always cut all visible fat from meat before cooking and cook without adding extra fat.

3. Remove the skin from poultry before eating, as a layer of fat lies attached to the skin. White meat has less natural fat than the moister dark meat.

4. Buy water-packed canned fish or rinse oil from fish with hot water before using.

5. Use lemon juice, herbs, or onion flakes with seafood dishes for added flavor and variety. Fish is an economical and low-fat meat exchange.

6. Use seasoned tomato juice or bouillon in meat, fish, and poultry recipes instead of creamed gravies and rich sauces.

7. Try cooking with dry wines. Most of the calorie-rich alcohol evaporates in the cooking but leaves a flavorful sauce. Sweet wines, however, contain more sugar and have more calories.

8. Try to combine meat and fruit for flavor variations. Pineapple with chicken or apples with ham are two suggestions.

9. To encourage the use of organ meats, try combining smaller amounts of them with other meats. Liver with ham and steak with kidney are two possibilities.

CEREAL EXCHANGES

1. Try a variety of breads--herb, whole wheat, rye, cheese, cinnamon, and spiced breads--to add interest to meals. A slice of cinnamon toast and fruit can substitute for a rich dessert.

2. Try making homemade bread. It will be appreciated as much or more than home-prepared calorie-rich desserts.

3. Carbohydrate-rich vegetables are included in the cereal exchange list. Dried peas, beans, and lentils when combined with small amounts of meat are good sources of protein and can be used to extend meat dishes for economy.

*From Stuart, R. B., & Davis, B. Slim chance in a fat world--behavioral control of obesity. Champaign, Ill.: Research Press, 1972.

FRUIT EXCHANGES

1. Use a variety of fruits and try them as appetizers, with a main course, or as a dessert.

2. Canned fruit juices should be purchased without added sugar. This requires reading the labels on the cans carefully.

3. Avoid both canned and frozen fruit that have sugar added. Both water-packed canned fruits and sugar-free frozen fruits are surprisingly flavorful and sweet. For economical reasons, canned fruits are sometimes the most sensible buy. If water-packed fruits are not available, choose fruits preserved in a light syrup, rinse the syrup from the fruit before using and count as one fruit exchange and one miscellaneous food exchange.

VEGETABLE EXCHANGE

1. Cook vegetables in a small amount of rapidly boiling water until just tender in order to retain flavor, nutrient content, and a pleasing texture. Save the liquid for soups. Try boiling in bouillon, or steam or bake vegetables for variety.

2. Peel only a thin layer of skin when preparing vegetables to retain the nutrients found right under the skin. Scrub young vegetables instead of peeling.

3. Experiment with herbs, spices, seasoned salts, vinegar, or lemon juice for added flavor.

4. Try interesting combinations of cooked vegetables such as cauliflower and peas, peppers and onions, or broccoli and mushrooms.

5. Use combinations of raw vegetables as salads, snacks, and appetizers. Try vegetables that are not usually served raw, such as cauliflower and mushrooms. Add salt or herbed vinegar for flavor. Use vegetable dips of herbed whipped cottage cheese with raw vegetables for an occasional hors d'oeuvre treat. Raw vegetables, due to their bulk, are eaten in less quantity than when cooked. They are considered calorie-free foods and do not need to be recorded on the daily food plan. Add salt or herbed vinegar for flavor.

MILK EXCHANGES

1. Use milk products that have had the milk fat removed (skimmed milk), for the calorie value is halved. Because the fat-soluble vitamin A is removed with the milk fat, get skimmed milk fortified with both Vitamins D and A. Both fluid and dry skim milk are sold fortified. The use of dried skim milk powder in cooking and as a beverage is an economical measure. If mixed well in advance

and allowed to become thoroughly chilled, the flavor is comparable to fluid skimmed milk.

2. Milk exchanges may also be used in soups, eggnogs, custards, and on cereals.

3. Find recipes that substitute low-calorie milk products for the calorie-rich creams commonly used in desserts, toppings, and dips. Whipped evaporated skimmed milk can replace whipped creams in some desserts; whipped cottage cheese or yogurt can replace sour cream or mayonnaise in salad and fruit dressings and dips; and flavored skim milk powder can be whipped and used instead of whipped cream.

4. Try plain yogurt and unsweetened fruit, or plain yogurt sprinkled lightly with brown sugar and cinnamon. The calorie value of commercially flavored yogurt will vary with the brand but in general will be twice as high as plain yogurt.

5. Ice milk is a good source of calcium and is included on the milk exchange list. Choose it in preference to ice cream and measure amounts carefully.

MISCELLANEOUS FOODS

1. Fat has over twice as many calories per gram as carbohydrates or protein. Measure accurately when using butter, margarine, and oils.

2. Margarines and vegetable oils contain polyunsaturated fatty acids which are a dietary essential. It is wise not to completely exclude such foods from a diet.

3. Low-calorie cookbooks have a variety of suggestions for salad dressings.

4. When choosing wine as a beverage, use light dry wines instead of the more caloric sweet heavy ones.

5. Use club soda, water, or ice as a mixer with alcoholic beverages.

6. On social occasions substitute low-calorie beverages for alcoholic drinks but drink them from regular wine, cocktail, or liquor glasses.

7. Avoid all the high-calorie appetizers that frequently accompany alcoholic beverages.

8. Some low-calorie desserts, such as angel food cake, jello, and sherbet, have been included in the miscellaneous exchange list. Other desserts may be found in low-calorie cookbooks and may be used as well, but such desserts should not supply more than 80 calories per serving. They may be used alone or in combination with fruits.

FOODS WITH NEGLIGIBLE CALORIES

1. Experiment with herbs, spices, vinegars, and seasonings to add flavor and interest to foods.

2. Use hot herbed teas, iced tea, decaffeinated coffee, and hot bouillons when you are not really hungry but feel like eating or drinking something.

3. Limited amounts of sugar substitutes may be used as flavoring. Recent research has indicated saccharin to be noncarcinogenic, and it has been included on the calorie-free list. However, it is not recommended that any sugar substitute be used indiscriminately, as reconditioning of the desire for concentrated sweets is needed. Besides, little is known about the long-term effects of such substitutes. For the same reason, read the labels of diet pop for calorie content and limit intake. They may have to be counted as one or more miscellaneous exchanges.

4. Keep a selection of raw vegetables prepared in airtight containers in the refrigerator so they are handy for snacks. It is important that they be prepared beforehand and available immediately in order to resist the temptation of instant high-calorie snack foods.

Appendix G

Average Energy Expenditure During Recreational Activities*

VALUES FOR GROSS ENERGY EXPENDITURE

Light Exercise 4 calories/minute	Moderate Exercise 7 calories/minute	Heavy Exercise 10 calories/minute
Dancing (slow step)	Badminton (singles)	Calisthenics (vigorous)
Gardening (light)	Cycling (9.5 mi./hr.)	Climbing stairs (up & down)
Golf	Dancing (fast step)	Cycling (12 mi./hr.)
Table tennis	Gardening (heavy)	Handball, paddleball, squash
Volleyball	Stationary cycling (moderately)	Jogging
Walking (3 mi./hr.)	Swimming (30 yd./min.)	Skipping rope
	Tennis (singles)	Stationary cycling (quickly)
	Walking (4.5 mi./hr.)	Swimming (40 yd./min.)

*From Stuart, R. B., & Davis, B. Slim chance in a fat world--behavioral control of obesity. Champaign, Ill.: Research Press, 1972.

Appendix H

Suggested Environmental-Behavioral Manipulations*

CUE ELIMINATION

Arrange to eat in only one room.
Arrange to eat in only one place in that room.
Do not engage in any other activity while eating.
Avoid the purchase of problematic foods by shopping from list after eating.
Do not serve high-calorie condiments at meals.
Allow children and spouses to take their own sweets.
Clear plates directly into the garbage.
Make problematic eating as difficult as possible (i.e., purchase only high-calorie foods that require preparation in individual units).

CUE SUPPRESSION

Reprogram the social environment to render the use of food as constructive as possible (i.e., provide for positive cueing of desirable behavior and positive reinforcement for acceptable eating).
Have others monitor eating patterns.
Minimize contact with excessive food (i.e., serve on plates in measured small quantities and leave the table soon after the meal is finished).
Make small portions of food appear to be as large as possible (i.e., serve on salad plates).
Control state of deprivation (i.e., eat at regular hours, avoid fatigue due to loss of sleep, and avoid boredom through use of nonfood related activities).

CUE STRENGTHENING

Provide a reasonable array of acceptable food choices.
Provide feedback about the amount which can be eaten.
Save allowable foods from meals for later meals.

RESPONSE STRENGTHENING

Slow the pace of eating (i.e., interpose a 2- to 5-minute delay shortly after the start of the meal, put utensils down between bites, chew all food slowly, and swallow food in mouth before taking additional food).
Signify the end of meals by brushing teeth or chewing sugar-free gum.
Learn to refuse food graciously.

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*From Stuart, R. B., & Davis, B. Slim chance in a fat world--behavioral control of obesity. Champaign, Ill.: Research Press, 1972.

Have social monitors respond neutrally to all negative deviations from the weight control plan.
Bring into focus the ultimate and immediate aversive consequences of overeating.

ACCELERATING CONSEQUENCES

Update eating and exercise graphs daily and weight change graph weekly.
Arrange for the provision of material reinforcement following completion of eating and exercise requirements and/or weight loss.
Provide social reinforcement for all constructive efforts to modify weight-relevant behavior.

Appendix I

Questionnaire

1. What is your marital status?

2. With which other weight reduction programs have you been associated?

3. How much weight did you lose as a result of this participation?

4. Why were these programs ineffective in maintaining your weight loss?

5. What have been the most effective components of the present weight reduction program? Please list in order of importance.
   1.
   2.
   3.

6. What have been the least beneficial components of the present weight reduction program? Please list in order of importance.
   1.
   2.
   3.

7. What behavioral changes have you developed that have helped you more effectively control your problematic eating? Please list behavioral changes other than those recommended by the administrator.

8. How many meals were you to consume each day?

9. How many meals did you regularly consume each day?

10. What percent of the time did you consume your prescribed number of meals?

11. Please rate your degree of satisfaction with your prescribed eating regimen.

1	2	3	4	5
Extremely Dissatisfied				Extremely Satisfied

12. Please rate your degree of satisfaction with the entire weight reduction program.

1	2	3	4	5
Extremely Dissatisfied				Extremely Satisfied

13. Please rate the administrator's effectiveness as an instructor.

1	2	3	4	5
Very Ineffective				Very Effective

14. Please rate the administrator's effectiveness in motivating and reinforcing weight loss.

1	2	3	4	5
Very Ineffective				Very Effective

15. What monetary value would you consider appropriate for the instruction and treatment you received?

16. How often during follow-up would you consider it beneficial to meet to record your weight loss?

17. How often would you be willing to meet?

18. Please give any specific suggestions that could aid the administrator in improving the effectiveness of the weight reduction program.